OVERVIEW

Recent discoveries by NASA missions to Mars such as the Mars Science Laboratory (MSL) rover named “Curiosity” and instruments on orbiting satellites have found large amounts of water in the form of water ice at the higher latitudes and also hydrated minerals globally on Mars. They are the result of ancient clays and clay-like minerals called phyllosilicates, or other poly-hydrated sulfates that formed millions of years ago in wet environments on the surface or underground. Capturing this water is the key to allow humans to “live off the land” or in scientific terms “In-Situ Resource Utilization (ISRU)”. The water can be used for human consumption, hygiene, to make rocket propellant for the journey home, grow plants, to provide radiation shielding and for various manufacturing processes. Before the water can be used in a human Mars station, the granular minerals which contain the water must be mined, or the soil overburden must be removed, to expose the water ice. The minerals and soil are typically in the form of crushed and weathered rock called “regolith”.

This Competition is for university-level students to design and build a mining robot that can traverse the challenging simulated Martian terrain. The mining robot must then excavate the basaltic regolith simulant (called Black Point-1 or BP-1) and/or the ice simulant (gravel) and return the excavated mass for deposit into the collector bin to simulate an off-world, in-situ resource mining mission. The complexities of the challenge include the abrasive characteristics of the basaltic regolith simulant, the weight and size limitations of the mining robot and the ability to tele-operate it from a remote Mission Control Center (MCC). The On-Site Mining category will require teams to consider a number of design and operation factors such as dust tolerance and dust projection, communications, vehicle mass, energy / power required, and autonomy.

NASA will directly benefit from the competition by encouraging the development of innovative robotic excavation concepts from universities which may result in clever ideas and solutions which could be applied to an actual excavation device and/or payload on an ISRU mission. The unique physical properties of basaltic regolith and the reduced 3/8th of Earth gravity make excavation a difficult technical challenge. Advances in Martian mining have the potential to significantly contribute to our nation’s space vision and NASA space exploration operations.